

REMARKS

Status of Claims:

Claims 1-31 are pending in the application. Each claim defines an invention that is novel and unobvious over the cited art. Favorable consideration of this case is respectfully requested.

Declaration Under 37 CFR 1.131:

The Examiner considered the declaration filed November 24, 2003, but considered it ineffective to overcome the Pike (6,420,097) reference. The Examiner cited, *inter alia*, *In re Harry*¹ for the proposition that the declaration failed to show diligence from a time prior the Pike reference.

The *Greenwood* case² discussed *Harry* and the requirements set forth in 37 CFR 1.131. "Under Rule 131, publications can be antedated and eliminated as references upon the filing of an affidavit by the inventor showing completion of the invention before the dates of the publications."³ Moreover, Rule 131 sets forth two ways to antedate a reference publication. *Greenwood*, 711 F.Supp. at 32 ("The two ways to do so are..."). The first way, the method chosen by the Applicants in the Declaration of November 24, 2003, is to "show 'reduction to practice' of the invention prior to the date of the reference."⁴ The Examiner stated that the evidence submitted was insufficient to show "diligence." While specifically not admitting to any alleged lack of diligence, the Applicants note that the "diligence" requirement relates to the second of two means to disqualify a reference.⁵ The two methods are (1) reduction to practice, or (2) conception and diligence.

¹ *In re Harry*, 333 F.2d 920, 142 USPQ 164 (CCPA 1964).

² *Greenwood v. Seiko Instruments & Electronics, Ltd.*, 711 F.Supp. 30 (D. DC 1989).

³ *Greenwood*, 711 F.Supp. at 32.

⁴ *Greenwood*, 711 F.Supp. at 32.

⁵ The two ways to antedate a reference publication are to show reduction to practice, "or (2) show conception of the invention prior to the date and due diligence." *Greenwood*, 711 F.Supp. at 32.

Figure 4, as described in the specification, as filed, shows reduction to practice of the entire invention, as claimed.⁶ The Examiner stated that "the only mention of Figure 4 in the specification is in the Brief Description of the Drawings." However, the Examiner's attention is directed to page 9 of the specification which demonstrates the successful testing of the entire invention, as claimed:

The last step of the process involves transferring of the developed image in the top layer 7, through the underlayer 6, and stopping on substrate 1 by known, oxygen-reactive ion etching techniques. Oxygen-reactive ion etching techniques are well known in the art and equipment to etch film is commercially available. The developed film has high aspect ratio, high etch resistance, enhanced resolution, and straight wall profiles.

Turning now to Figure 3, an embodiment of the present invention provides control over the extent to which the lateral trimming proceeds. The variation in CD with respect to etching time for isolated lines with two different widths is shown in Figure 3. The lines as photo-imaged were 185 nm (L-181) and 220 nm (L-182) before they were transferred into the underlayer. SEM micrographs of the unetched L-181 sample and 60% overetched L-181 sample are shown in Figure 4 where one can observe the drastic reduction in line-width. At the end of the etch (0% overetch), there is a CD loss which can be determined by extrapolating the dashed lines and subtracting this value from the as-imaged CD. As the patterns were overetched longer, an approximately linear decrease in CD was observed.

Figure 4 presents a successful test of the entire invention at a date prior to the publication of the Pike reference. In view thereof, the Applicants respectfully request that the Pike reference be disqualified and rejections based thereon be withdrawn.

Rejections Under 35 U.S.C. § 112, 2nd Paragraph:

Claims 1-26 and 31 were rejected under 35 U.S.C. § 112, 2nd Paragraph, as being indefinite over the recitation "tuned polymer."

⁶ "Reduction to practice means that [the inventor] must show that the invention as claimed in the patent was actually constructed and sufficiently tested to demonstrate that it will work for its intended purpose." *Greenwood*, 711 F.Supp. at FN1; *Barmag Barmer Maschinenfabrik v. Murata Machinery Ltd*, 731 F.2d 831, 221 USPQ 561 (Fed.Cir.1984).

A person of skill in the art would understand "tuned polymer" from the context of the disclosure. Examples of a tuned polymer were recited including thermally linked dyed phenolic polymers (page 8, lined 4-5), epoxies, and diamond-like carbon (claim 19). Moreover, various properties of a tuned polymer suitable for the invention were disclosed at page 7, line 21 to page 8, line 2. The properties included a specified range of refractive index at the imaging wavelength, extinction coefficient, and controlled interaction between the top and bottom layer. Given the disclosure of suitable type of polymer and suitable properties, a skilled artisan would readily be able to select an appropriate polymer for the resist. The concept of a tuned polymer was disclosed in the scientific literature.⁷ Lin et al teach: The optical properties of the base polymer can be easily tuned to match the required optimum values."⁸ In accord with Lin et al., the present disclosure teaches that properties that may be tuned in the relevant polymers include refractive index and extinction coefficient.⁹

Rejection Under 35 U.S.C. § 103(a):

Claims 1-8, 12, 13, 17, 18, 20, and 22-30 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Pike (6,420,097) in view of allegedly admitted prior art.

The Applicant has not characterized any reference as "prior art" and expressly denies any such "admission."

In view of the discussion of the declaration (see above), the Applicants respectfully request the withdrawal of the Pike reference.

In the alternative, the Applicants respectfully traverse the rejection over Pike. To establish *prima facie* obviousness of a claimed invention, all the claim recitations must be taught or suggested by the prior art. *In re Royka*.¹⁰ All words in a claim must be considered in judging the patentability of that claim against the prior art. *In re Wilson*.¹¹ (MPEP § 2143.03). When evaluating the scope of a claim, every limitation in the claim

⁷ Lin et al., *A High Resolution 248 nm Bilayer Resist*. 3678 SPIE 241 (1999) (IDS previously submitted).

⁸ Lin et al., page 246, lines 7-6 from bottom.

⁹ Page 7, lines 21-25.

¹⁰ *In re Royka*, 490 F.2d 981, 180 USPQ 580 (CCPA 1974).

¹¹ *In re Wilson*, 424 F.2d 1382, 165 USPQ 496 (CCPA 1970).

must be considered. See e.g. *In re Ochiai*.¹² (MPEP § 2144.08). The evidentiary record fails to teach each limitation of the present invention. Specifically, the Pike reference fails to teach the bilayer resist of the present invention.

The present invention recites: "providing an underlayer on [a semiconductor] substrate."¹³ The present invention defines the substrate as a semiconductor wafer processed through application of a hardmask.¹⁴ Pike also defines a substrate to be a wafer processed through application of a hardmask.¹⁵ The hardmask of Pike is defined:¹⁶

The materials for forming the hardmask layer 118 may be inorganic films such as silicon dioxide, silicon nitride, silicon oxynitride, and titanium nitride or organic films such as a bottom anti-reflective coating (BARC). The BARC is typically a water soluble fluoropolymer, such as Shipley AR19 which is commercially available from Shipley Corporation of Sunnyvale, Calif. The hardmask layer 118 has a thickness between 50Å and 500Å.

Note that the substrate of Pike includes a hardmask which hardmask may be a BARC.

The present invention applies a layer over the hardmask. "The hardmask 5 is coated with an underlayer 6 comprising a tuned polymer."¹⁷ "The underlayer is a material substantially free of any element that forms a non-volatile oxide, e.g. silicon, boron, phosphorous, germanium, or aluminum."¹⁸ The Examiner construes the claims to equate the underlayer of the present invention with the hardmask of Pike (asserting the BARC of Pike is equivalent to the underlayer. However, Pike explicitly defines the hardmask to include a BARC. Moreover, the underlayer of the present invention is applied over the hardmask, so cannot be equivalent to the hardmask.

The present invention comprises a layer applied over a hardmask; said layer being:

"from about 400 nanometers to about 2000 nanometers and preferably about 800 nanometers."¹⁹

¹² *In re Ochiai*, 71 F.3d 1565, 37 USPQ2d 1127 (Fed. Cir. 1995).

¹³ Claim 1, lines 3-4.

¹⁴ Page 7, lines 17-18.

¹⁵ US 6,420,097, column 3, lines 65-66.

¹⁶ US 6,420,097, column 4, lines 4-12.

¹⁷ Page 7, lines 18-19.

¹⁸ Page 4, lines 3-5.

¹⁹ Page 7, lines 19-20.

Note that 400 nanometers equals 4,000Å. Over a hardmask, Pike applies a layer of an ultra thin resist (UTR). "In FIG. 4(b), an UTR layer 120 is deposited on top of the hardmask layer 118 in accordance with the step 304 of FIG. 3."²⁰ The UTR layer is less than 2500Å. "The UTR layer 120 has a thickness of less than 2500Å."²¹

The UTR of Pike is not properly equivalent to the underlayer of the present invention because the UTR is the image forming layer,²² whereas the present invention forms an image in a layer applied over the underlayer.²³ Pike does not provide a photoresist layer applied over the UTR layer.

For all the above reasons, Pike does not teach, and therefore, cannot render obvious, each recitation of the present invention. In view thereof, the Applicants respectfully request the rejection be withdrawn.

Conclusion:

In view of the above, consideration and allowance are, therefore, respectfully solicited.

Accordingly, it is respectfully requested that the foregoing amendments be entered, that the application as so amended receive an examination on the merits, and that the claims as now presented receive an early allowance.

In the event the Examiner believes an interview might serve to advance the prosecution of this application in any way, the undersigned attorney is available at the telephone number noted below.

²⁰ US 6,420,097, column 4, lines 1-3.

²¹ US 6,420,097, column 4, lines 12-13.

²² "In FIG. 4(c), the UTR layer 120 is patterned to a resist mask 122 which has an initial linewidth 124." US 6,420,097, column 4, lines 14-15.

²³ It is desirable that the physical properties of the tuned polymer 6 include an optimized interaction between the polymer layer and top, imaging layer 7. Polymer layer 6 should be strongly adherent to imaging layer 7, but polymer layer 6 should not intermix with imaging layer 7. (Page 7, line 26- page 8, line 2).

The Commissioner is hereby authorized to charge any fees or credit any overpayment associated with this communication, including any extension fees or fees for the net addition of claims, to Deposit Account No. 22-0185.

Respectfully submitted,



John A. Evans, Reg. No 44,100
CONNOLLY, BOVE, LODGE & HUTZ LLP
1990 M Street, N.W., Suite 800
Washington, D.C. 20036-3425
Telephone: 202-331-7111
Facsimile: 202-293-6229
Attorney for Applicants

Date: June 8, 2004